Hazard Elimination Project Evaluation

Project Log #'s 200608064

Hazard Elimination Projects W-4410

Evaluation of Shoulder Guardrail Installation on US 74/19
From Cherokee County Line in Macon County to NC 28 in Swain County

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
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Principal Investigator

_____ 3/31/2008
Brad Robinson Date

Traffic Safety Project Engineer

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project W-4410 – Installation of shoulder guardrail on US 74/19 from Cherokee County line in Macon County to NC 28 in Swain County.

Project Information and Background from the Project File Folder

The safety countermeasure chosen for the subject location was the installation of approximately 45,400 linear feet of shoulder guardrail. US 74/19 is a two lane facility with a variable shoulder width between two and ten feet. The speed limit through Macon County is 45 mph, while the speed limit varies between 35 and 50 mph in Swain County. According the project folder the narrow shoulder width, horizontal curves, and the proximity of the Natahala River are contributing factors in the severity of the ran off road crashes.

The initial crash analysis for this location was completed from January 1, 1989 through December 31, 1991 with a total of 86 reported crashes. Ran Off Road crashes made up 65 percent of the total crashes. The guardrail was installed to reduce the severity of the pattern of ran off road crashes. The project was completed on April 23, 2002 with a total cost of $1,150,000.00

Naïve Before and After Analysis

After reviewing the hazard elimination project file folder along with all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period was from June 1, 2001 through May 31, 2002. The before period consisted of reported crashes from April 1, 1996 through May 31, 2001 (5 Years, 2 Months) and the after period consisted of reported crashes from June 1, 2002 through July 31, 2007 (5 Years, 2 Months). The ending date for this analysis was determined by the available after period crash data.

The treatment data consisted of all crashes on US 74/19 in from the Cherokee County line in Macon County to NC 28 in Swain County, a distance of approximately 14 miles. A 0 foot y-line was used. Please see the attached *Location Map* for further detail.

The following table depicts the Naïve Before and After Analysis for the Total Crashes and Target Crashes at the treatment location. Please note that Ran Off Road crash types were the target crashes for the applied countermeasure. Ran Off Road crash types considered are as follows: Ran Off Road – Left, Ran Off Road – Right, Ran Off Road – Straight, Fixed Object, Head-on, Sideswipe – Same Direction, Sideswipe – Opposite Direction, and Overturn / Rollover.

Treatment Information	**Before**	**After**	**Percent Reduction (-)/ Percent Increase (+)**
Total Crashes	191	139	-27.2
Total Severity Index	14.07	11.74	-16.6
Total Target Crashes	115	102	-11.3
Target Severity Index	17.61	13.94	-20.8
Volume	4,700	6,700	42.6

Target Crash Information	**Before**	**After**	**Percent Reduction (-)/ Percent Increase (+)**
Target Crashes - Injuries			
Fatal Injury Crashes	3	1	-66.7
Non-Fatal Injury Crashes	61	48	-21.3
Total Injury Crashes	64	49	-23.4
Target Crashes - Contributing Factors			
Night Crashes	46	42	-8.7
Wet Crashes	34	31	-8.8
Target Crashes - Crash Types			
Ran Off Road	77	7	-90.9
Fixed Object	12	63	425.0
Sideswipe-Total	20	18	-10.0
Head On	3	6	100.0
Overturn / Rollover	3	8	166.7
Target Crashes – Crash Severity Summary			
Fatal Crashes	3	1	-66.7
Class A Crashes	18	13	-27.8
Class B Crashes	24	17	-29.2
Class C Crashes	19	18	-5.3
Property Damage Only Crashes	51	53	3.9

The naïve before and after analysis at the treatment location resulted in a 27 percent decrease in Total Crashes, an 11 percent decrease in Target Crashes, and a 43 percent increase in Average Daily Traffic (ADT). Further investigation shows there was a 17 percent decrease in the Total Severity Index and a 11 percent decrease in the Target Crash Severity Index. The before period ADT year was 1998 and the after period ADT year was 2004.

Results and Discussion

The naïve before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 27 percent decrease in Total Crashes and an 11 percent decrease in Target Crashes. Further investigation shows that the Total Severity Index decreased by 17 percent and the Target Crash Severity Index decreased by 11 percent using from the before to the after period. The summary results above demonstrate that the treatment location appears to have had

an decrease in both Total Crashes and Target Crashes as well as a decrease in the Severity Indexes from the before to the after period.

The calculated benefit to cost ratio for this project is 6.84 considering total crashes. The benefit to cost ratio considering only target crashes is 4.16. The benefits are calculated using the change in annual crash costs from the before to the after period. Operational and other benefits related to the project are not considered in this analysis. The costs of the project include the actual constructions costs as well as the increase in annual maintenance and utility costs.

It should be noted that there was no specific information in the project file as to exactly where each run of guardrail was placed in this project. Therefore specific crash information for each run of guardrail could not be analyzed. The site visit confirmed where guardrail exists along the segment today, but there was no way to determine where guardrail existed before the project.

Typically, one would expect guardrail installation projects to result in an increased number of Ran Off Road Crashes and a decrease in the severity of Ran Off Road crashes. The increase in Ran Off Road Crashes is expected due to the placement of a fixed object (guardrail) near the travel way. The decrease in the severity of Ran Off Road Crashes is expected due to the guardrail being more forgiving than the object it is protecting. The results from this project differ from these expectations in that Ran Off Crashes actually decreased from the before to the after period, although much less so than Total Crashes did (Total Crashes decreased by 52 crashes, while Target Crashes decreased by 13 crashes). The Severity of Ran Off Road crashes decreased as expected.

Crashes coded as Fixed Object Crashes seemed to undergo a large increase (425%) while crashes coded as Ran Off Road appeared to undergo a large decrease (90%) from the before to the after period. Although the guardrail installation helped contribute to these numbers, it should be noted that Fixed Object Crashes were re-defined for law enforcement officers in the year 2000. For example, a vehicle running off the roadway and hitting a tree or ditch might have been coded as a Ran Off Road Crash in the years before 2000, while a similar crash in the after period might have been coded as a Fixed Object Crash after 2000.

It should also be noted that there was no crash type for “Sideswipe-Opposite Direction” on crash reports before the year 2000. For this reason, Sideswipe-Opposite Direction and Sideswipe-Same Direction Crashes were combined into the “Sideswipe-Total” category for a more appropriate before and after comparison.

Please see the attached Treatment Site Photos for additional visual information. As the Safety Evaluation Group completes additional reviews for this type of countermeasure, we will be able to provide more objective and definite information regarding actual crash reduction factors.

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US 64 from Cherokee CL to NC 28 BY: Brad Robinson
COUNTY: Macon and Swain County DATE: 3/27/2008
FILE NO.: W-4410

DETAILED COST: TYPE IMPROVEMENT - Shoulder Guardrail

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$1,150,000	10	0.149	$171,384
Right-of-Way	$0	0	0.000	$0
TOTALS	$1,150,000	10	0.149	$171,384

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $7,896
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $0

TOTAL ANNUAL COST= $179,280
TOTAL COST OF PROJECT= $1,150,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	5.17	26	5.03	71	13.73	94	18.18	$3,000,851
AFTER	5.17	15	2.90	48	9.28	76	14.70	$1,774,391

Annual Benefits from Crash Cost Savings $1,226,460

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $1,047,180

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 6.84

TOTAL COST OF PROJECT - $1,150,000 COMPREHENSIVE B/C RATIO - 6.84

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US 64 from Cherokee CL to NC 28 BY: Brad Robinson
COUNTY: Macon and Swain County DATE: 3/27/2008
FILE NO.: W-4410 Target Crashes

DETAILED COST: TYPE IMPROVEMENT - Shoulder Guardrail

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$0	0	0.000	$0
	$1,150,000	10	0.149	$171,384
Right-of-Way	$0	0	0.000	$0
TOTALS	$1,150,000	10	0.149	$171,384

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $7,896
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $0

TOTAL ANNUAL COST= $179,280
TOTAL COST OF PROJECT= $1,150,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	5.17	21	4.06	43	8.32	51	9.86	$2,351,277
AFTER	5.17	14	2.71	35	6.77	53	10.25	$1,605,861

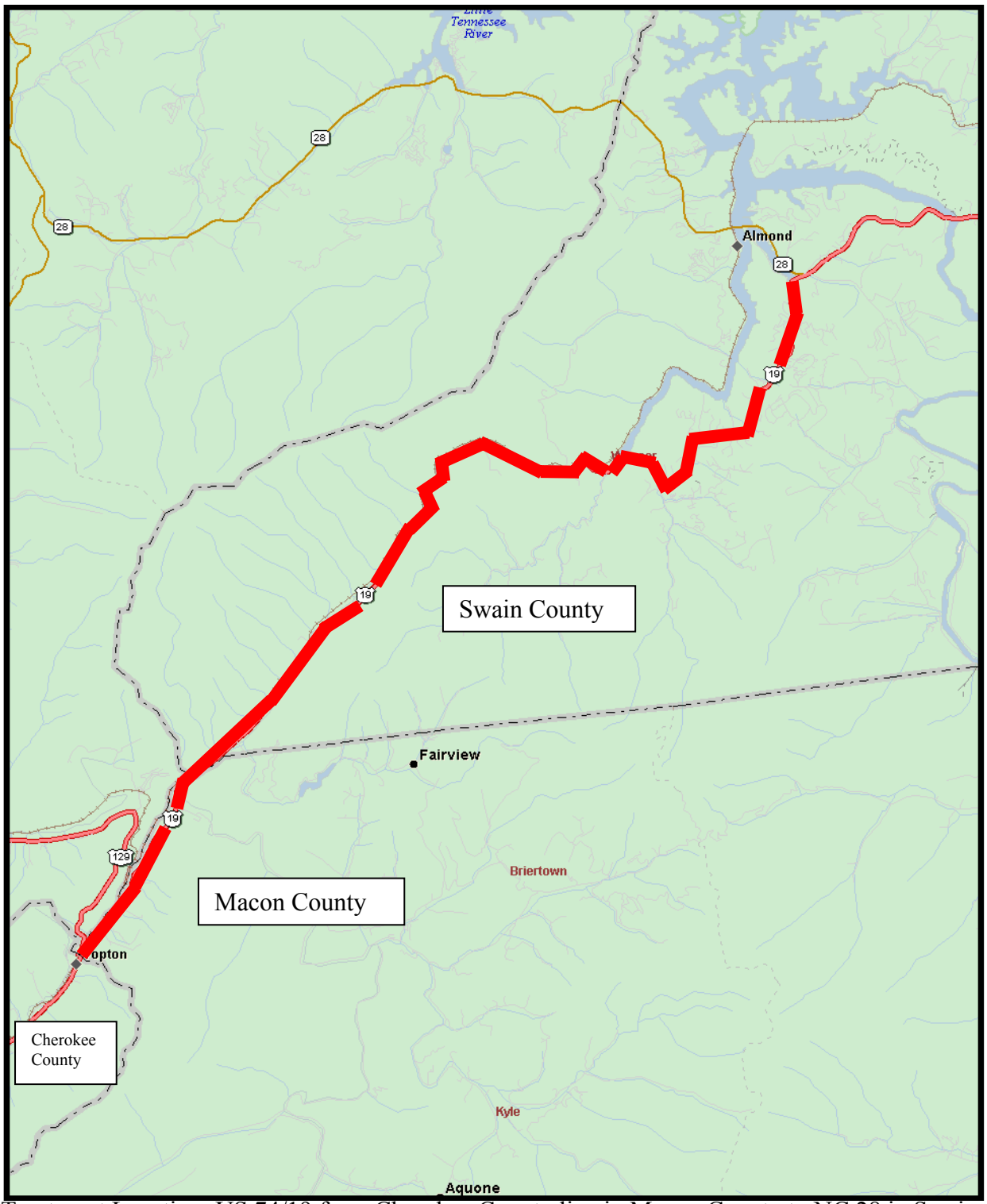
Annual Benefits from Crash Cost Savings $745,416

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $566,136

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 4.16

TOTAL COST OF PROJECT - $1,150,000 COMPREHENSIVE B/C RATIO - 4.16

Location Map
Macon/Swain Counties
Evaluation of W-4410



Treatment Location: US 74/19 from Cherokee County line in Macon County to NC 28 in Swain County

Treatment Site Photos Taken March 18, 2008

Traveling Westbound on US 74/19

Traveling Westbound on US 74/19

Traveling Westbound on US 74/19

Traveling Westbound on US 74/19